Towards Understanding Why Climate Models Exhibit Different Sensitivities

Principal Investigator: Edwin K. Schneider
Co-Principal Investigator: Lennart Bengtsson

This research will implement a pilot project to determine whether the differences between the temperature and precipitation sensitivities of different climate models to increasing CO_2 can be isolated and understood. There are two components to the project. The first concerns the direct response of the models, and the second the indirect response.

The examination of the direct response will determine the causes of differences between the equilibrium global climate sensitivities of several atmospheric GCMs. Differences between a pair of atmospheric GCMs will be eliminated by transferring parameterizations from one model into the other and by other manipulations of the model code. The equilibrium climate sensitivities of the hybrid models will be calculated, and the role of the separate parameterizations in causing the differing climate sensitivities will be identified. This procedure will then be repeated with another pair of models. Identification of the parameterizations responsible for differences will allow further experiments to be designed to understand the sensitivity differences in terms of the underlying physical mechanisms. In this first attempt, the comparison will be limited to three AGCMs that span the range of sensitivities: CCM3 (low), ECHAM4 (medium), and CSIRO (high).

The indirect response involves the interaction between the climate change in different regions. The research will investigate (a) the magnitude of the higher latitude response of different atmospheric models to greenhouse-related tropical forcing and (b) the extent to which the differences in the higher latitude (especially North Atlantic) responses of some of the coupled models in the CMIP2 model intercomparison can be related either to forcing from the tropics or internal atmospheric dynamics. The experimental procedure will be to compare simulations with the above AGCMs forced by various tropical SST distributions, including those taken from observations and produced in the CMIP2 integrations.